

3-input MATH FUNCTION MODULE (field-programmable)

MODEL

JFK

BEFORE USE

Thank you for choosing M-System. Before use, please check contents of the package you received as outlined below. If you have any problems or questions with the product, please contact M-System's Sales Office or representatives.

■ PACKAGE INCLUDES:

Signal conditioner (body + base socket).....(1)

■ MODEL NO.

Confirm Model No. marking on the product to be exactly what you ordered.

■ INSTRUCTION MANUAL

This manual describes necessary points of caution when you use this product, including installation, connection, hardware setting and basic maintenance procedures. When you need to change software settings, please refer to the Operation Manual for Model PU-2x (EM-9255), Section A.

POINTS OF CAUTION

■ POWER INPUT RATING & OPERATIONAL RANGE

- Locate the power input rating marked on the product and confirm its operational range as indicated below:
AC power: Rating $\pm 10\%$, 50/60 ± 2 Hz, approx. 3VA
DC power: Rating $\pm 10\%$, approx. 2W

■ GENERAL PRECAUTIONS

- Before you remove the unit from its base socket or mount it, turn off the power supply and input signal for safety.

■ ENVIRONMENT

- Indoor use.
- When heavy dust or metal particles are present in the air, install the unit inside proper housing with sufficient ventilation.
- Do not install the unit where it is subjected to continuous vibration. Do not subject the unit to physical impact.
- Environmental temperature must be within -5 to $+55^{\circ}\text{C}$ (23 to 131°F) with relative humidity within 30 to 90% RH in order to ensure adequate life span and operation.

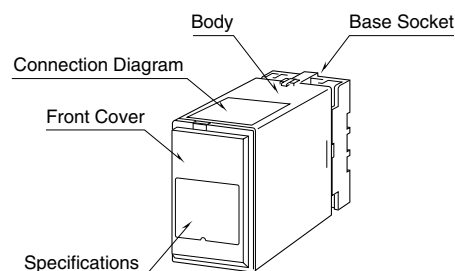
■ WIRING

- Do not install cables close to noise sources (relay drive cable, high frequency line, etc.).
- Do not bind these cables together with those in which noises are present. Do not install them in the same duct.

■ AND

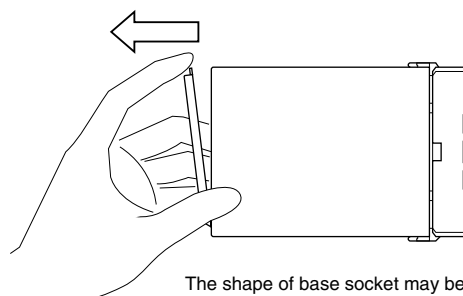
- The unit is designed to function as soon as power is supplied, however, a warm up for 10 minutes is required for satisfying complete performance described in the data sheet.

COMPONENT IDENTIFICATION



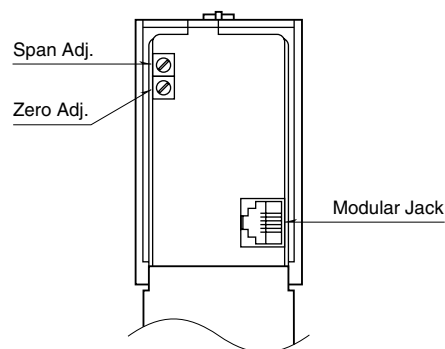
■ HOW TO OPEN THE FRONT COVER:

Hang your finger on the hook at the top of the front cover and pull.



The shape of base socket may be different for some models.

■ FRONT PANEL CONFIGURATIONS



INSTALLATION

Detach the yellow clamps located at the top and bottom of the unit for separate the body from the base socket.

■ DIN RAIL MOUNTING

Set the base socket so that its DIN rail adaptor is at the bottom. Hang the upper hook at the rear side of base socket on the DIN rail and push in the lower. When removing the socket, push down the DIN rail adaptor utilizing a minus screwdriver and pull.



■ WALL MOUNTING

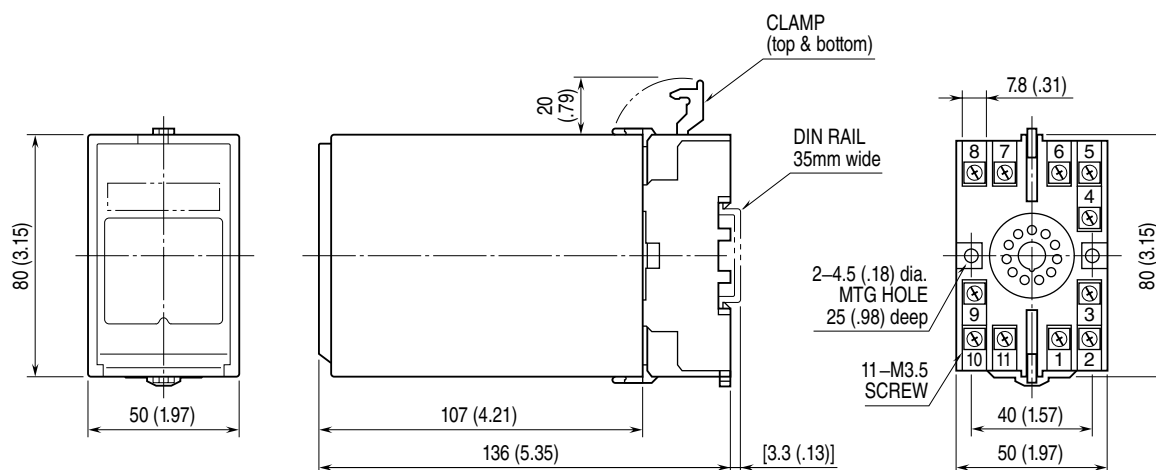
Refer to “EXTERNAL DIMENSIONS.”

Shape and size of the base socket are slightly different with various socket types.

TERMINAL CONNECTIONS

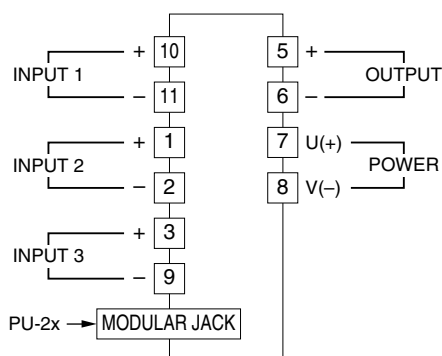
Connect the unit as in the diagram below or refer to the connection diagram on the top of the unit.

■ EXTERNAL DIMENSIONS unit: mm (inch)



• When mounting, no extra space is needed between units.

■ CONNECTION DIAGRAM



CHECKING

- 1) Terminal wiring: Check that all cables are correctly connected according to the connection diagram.
- 2) Power input voltage: Check voltage across the terminal 7 – 8 with a multimeter.
- 3) Input: Check that the input signal is within 0 – 100% of the full-scale.
- 4) Output: Check that the load resistance meets the described specifications.

ADJUSTMENT PROCEDURE

This unit is calibrated at the factory to meet the ordered specifications, therefore you usually do not need any calibration, unless you need to match the signal to a receiving instrument or conduct regular calibration.

Zero and span are adjusted with using the Programming Unit (model: PU-2x). Also, fine adjustments can be done with the potentiometers behind the front cover.

Refer to the Operation Manual for Model PU-2x for explanations how to use the programmer.

■ WARNING ON USE OF THE PROGRAMMING UNIT

- Be sure to disconnect the Programming Unit before you turn on/off power supply to the unit.
- The output signal is held when the Programming Unit is connected. You need to disconnect when confirming current output values.

■ HOW TO CALIBRATE THE OUTPUT SIGNAL

Use a signal source and measuring instruments of sufficient accuracy level. Turn the power supply on and warm up for more than 10 minutes.

• Fine Output Calibration Using the Programming Unit (ITEM 19, 20)

ITEM 19 is for Zero, and ITEM 20 is for Span.

- 1) Turn the unit into Program mode (ITEM 01).
- 2) Apply simulated 0% input. Increase/decrease values (default: 0%) at ITEM 19 until the output signal is calibrated to actual 0%.
- 3) Apply simulated 100% input. Increase/decrease value (default: 100%) at ITEM 20 until the output signal is calibrated to actual 100%.
- 4) Apply simulated 0% input again and check 0% output.
- 5) When 0% value is changed, repeat the above procedure 2) – 4).
The 0% value may be shifted when the output span is greater than the input span (gain > 1).

• Fine Output Calibration via the Front Potentiometers

- 1) ZERO: Apply 0% input and adjust output to 0%.
- 2) SPAN: Apply 100% input and adjust output to 100%.
- 3) Check ZERO adjustment again with 0% input.
- 4) When ZERO value is changed, repeat the above procedure 1) – 3).

MAINTENANCE

Regular calibration procedure is explained below:

■ CALIBRATION

Warm up the unit for at least 10 minutes. Apply 0%, 25%, 50%, 75% and 100% input signal. Check that the output signal for the respective input signal remains within accuracy described in the data sheet. When the output is out of tolerance, recalibrate the unit according to the “ADJUSTMENT PROCEDURE” explained earlier.

LIGHTNING SURGE PROTECTION

M-System offers a series of lightning surge protector for protection against induced lightning surges. Please contact M-System to choose appropriate models.

PROGRAMMABLE ITEMS

The following items can be monitored and programmed. For detailed explanations, please refer to the Operation Manual for Model PU-2x (EM-9255), Section A.

[GROUP 01]

ITEM	MDFY.	DATA INPUT	DISPLAY	CONTENTS
01	S			MAINTENANCE SWITCH (lock command)
		0	MTSW: MON.MODE	MONITOR mode: data monitoring only
		1	MTSW: PRG.MODE	PROGRAM mode: "P" marked data modifiable
02	P	Alphabets & No.	TG: XXXXXXXXXX	Tag name entry (10 characters max.)
03	P	Number (%)	OUTPER XXX.XX	Output status monitor (%) & simulation output
04	D	No input	INPER1 XXX.XX	X1: Input 1 status monitor (%)
05	D	No input	INPER2 XXX.XX	X2: Input 2 status monitor (%)
06	D	No input	INPER3 XXX.XX	X3: Input 3 status monitor (%)
07	D	No input	(X0) XXX.XXXX	X0: Normalization parameter monitor (1.0000=100%)
10	P			TYPE OF EQUATION
		1	X1 * SQR (X2 / X3)	Temp. & press. compensation for DP flowmeter $X_0 = K_1 X_1 \sqrt{\frac{K_2 X_2 + A_2}{K_3 X_3 + A_3}}$ where X ₁ = flow X ₂ = pressure X ₃ = temperature Specify ITEM 11 square root extraction for a square input X ₁ .
		2	X1 + X2 + X3	Addition & Subtraction $X_0 = K_0 (K_1 (X_1 + A_1) + K_2 (X_2 + A_2) + K_3 (X_3 + A_3)) + A_0$
		3	X1 * X2 * X3	Multiplication $X_0 = K_0 (K_1 X_1 + A_1)(K_2 X_2 + A_2)(K_3 X_3 + A_3) + A_0$
		4	(X1 * X2) / X3	Multiplication & Division $X_0 = \frac{K_0 (K_1 X_1 + A_1)(K_2 X_2 + A_2)}{K_3 X_3 + A_3} + A_0$
		5	X1 / (X2 * X3)	Multiplication & Division $X_0 = \frac{K_0 (K_1 X_1 + A_1)}{(K_2 X_2 + A_2)(K_3 X_3 + A_3)} + A_0$
		6	(X1 + X2) * X3	Addition & Multiplication $X_0 = K_0 (K_1 X_1 + K_2 X_2 + A_1)(K_3 X_3 + A_3) + A_0$
		7	(X1 + X2) / X3	Addition & Division $X_0 = \frac{K_0 (K_1 X_1 + K_2 X_2 + A_1)}{(K_3 X_3 + A_3)} + A_0$
		8	X1 / (X2 + X3)	Division & Addition $X_0 = \frac{K_0 (K_1 X_1 + A_1)}{(K_2 X_2 + K_3 X_3 + A_2)} + A_0$
		9	X1 + (X2 * X3)	Addition & Multiplication $X_0 = K_0 (K_1 X_1 + A_1) + K_0 (K_2 X_2 + A_2)(K_3 X_3 + A_3) + A_0$
		10	X1 + (X2 / X3)	Addition & Division $X_0 = K_0 (K_1 X_1 + A_1) + \frac{K_0 (K_2 X_2 + A_2)}{(K_3 X_3 + A_3)} + A_0$
11	P			SQUARE ROOT EXTRACTION FOR INPUT X ₁
		0	SQR NO OPTION	Without
		1	SQR OPTION	With
19	P	Percentage	FINZER	Fine zero adjustment Initial status shows actual bias (%). When data is entered, output (%) is shown.
20	P	Percentage	FINSPN	Fine span adjustment Initial status shows actual gain (%). When data is entered, output (%) is shown.

ITEM	MDFY.	DATA INPUT	DISPLAY	CONTENTS
21	P	Number	(K0) XX.XXX	Gain K ₀ (1.000 = 100%)
22	P	Number	(K1) XX.XXX	Gain K ₁ (1.000 = 100%)
23	P	Number	(K2) XX.XXX	Gain K ₂ (1.000 = 100%)
24	P	Number	(K3) XX.XXX	Gain K ₃ (1.000 = 100%)
25	P	Number (%)	(A0) XXX.XX	Bias A ₀ (%)
26	P	Number (%)	(A1) XXX.XX	Bias A ₁ (%)
27	P	Number (%)	(A2) XXX.XX	Bias A ₂ (%)
28	P	Number (%)	(A3) XXX.XX	Bias A ₃ (%)
29	P	Number (%)	X1LMTL XXX.XX	Input LOW limit X ₁ (-25.00 – +125.00%)
30	P	Number (%)	X2LMTL XXX.XX	Input LOW limit X ₂ (-25.00 – +125.00%)
31	P	Number (%)	X3LMTL XXX.XX	Input LOW limit X ₃ (-25.00 – +125.00%)
32	P	Number (%)	X1LMTH XXX.XX	Input HIGH limit X ₁ (-25.00 – +125.00%)
33	P	Number (%)	X2LMTH XXX.XX	Input HIGH limit X ₂ (-25.00 – +125.00%)
34	P	Number (%)	X3LMTH XXX.XX	Input HIGH limit X ₃ (-25.00 – +125.00%)

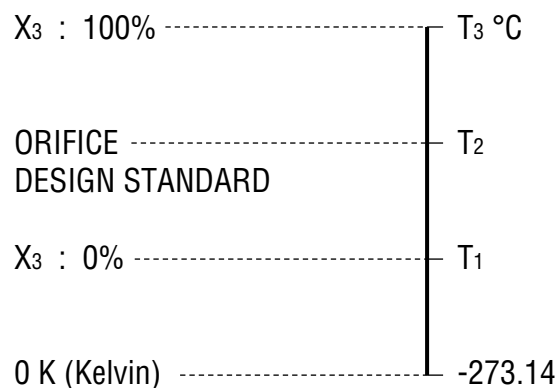
Modification Code

D: No modification (writing) possible. Used only for monitoring (reading).

S: Modifiable at any time.

P: Modifiable only when the MAINTENANCE SWITCH is in the “PRG” mode.

■ TEMPERATURE COMPENSATION FOR DP FLOWMETER



K_1 = I/O range scaling factor

K_1 = 1 when input & output ranges are identical.

$$K_3 = \frac{T_3 - T_1}{T_2 + 273.14} \quad A_3 = \frac{T_1 + 273.14}{T_2 + 273.14}$$

[EXAMPLE]

Temp. range of DP flowmeter: 0 – 400°C

Design standard of orifice: 300°C

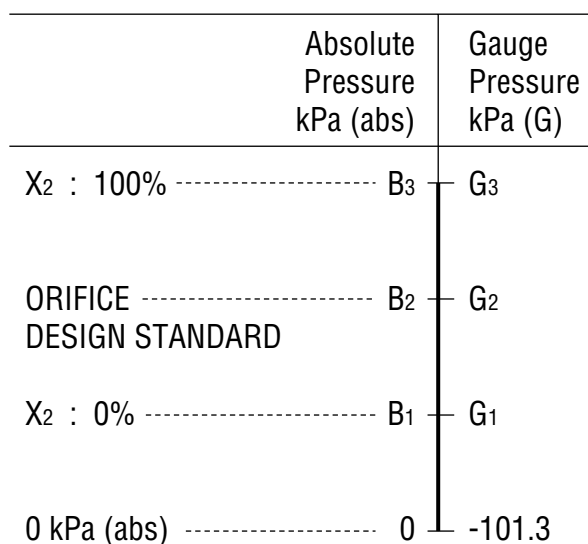
K_1 = 1

$$K_3 = \frac{400 - 0}{300 + 273.14} = 0.698$$

$$A_3 = \frac{0 + 273.14}{300 + 273.14} = 0.4766 = 47.66\%$$

■ PRESSURE COMPENSATION FOR DP FLOWMETER

Atmospheric pressure = 101.3 kPa (abs)



• Absolute Pressure

$$K_2 = \frac{B_3 - B_1}{B_2} \quad A_2 = \frac{B_1}{B_2}$$

• Gauge Pressure

$$K_2 = \frac{G_3 - G_1}{G_2 + 101.3} \quad A_2 = \frac{G_1 + 101.3}{G_2 + 101.3}$$

[EXAMPLE]

Press. range of DP flowmeter: 0 – 980 kPa (G)

Design standard of orifice: 686 kPa (G)

K_1 = 1

$$K_2 = \frac{980 - 0}{686 + 101.3} = 1.245$$

$$A_2 = \frac{0 + 101.3}{686 + 101.3} = 0.1287 = 12.87\%$$